ATTACHMENT Z-1
to
REVISED EXHIBIT A

ENVIRO-CHEM CORPORATION SUPERFUND SITE
ZIONSVILLE, INDIANA

Submitted to:

U.S. Environmental Protection Agency, Region 5
and
Indiana Department of Environmental Management

Submitted by:

ENVIRON International Corporation
Deerfield, Illinois

On behalf of
The ECC Site Trustees

February 2003

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1.0 INTRODUCTION

As presently configured, the soil vapor extraction (SVE) system that has been installed at the Enviro-Chem Corporation Superfund Site ("ECC" or "Site") has not achieved the subsurface water cleanup standards in the till set forth in Table 3-1 to Revised Exhibit A. United States Environmental Protection Agency (USEPA) and Indiana Department of Environmental Management (IDEM) are concerned that failure to achieve those cleanup standards may, over time, have an adverse effect on water quality in Unnamed Ditch, which is located adjacent to the eastern portion of the Site.

The Trustees representing the Settling Defendants propose to augment the existing SVE system with additional wells and trenches. Doing so along the alignment previously proposed in Revised Exhibit A for "Additional Work" will provide effective barrier protection to Unnamed Ditch. This SVE augmentation will be as protective of Unnamed Ditch as achieving subsurface cleanup standards. It also represents a quicker, more effective and lower cost alternative to the Additional Work referred to in Section 3.3 of Revised Exhibit A.

After completion of construction, there will be several distinct time periods for the operation of the Augmented SVE System. The activities will be different for each period. The periods and the associated activities are as follows:

A. Active Phase: This is defined as the period of operation of the Augmented SVE System.

B. Phase I Long Term Monitoring: This is defined as the 5-year period beginning when the Soil Vapor Standards have been achieved in both Separate Treatment Areas[1] and the Augmented SVE Trenches. At the completion of the Phase I Long Term Monitoring period, the activities dictated by the Consent Decree will be complete and the Site will enter an Indiana state program (i.e., Voluntary Remediation Program).

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[1] Separate Treatment Areas 1, 1A and 2, also referred to as the areas to be treated separately are depicted on Figure 6.

C. Phase II Long Term Monitoring: This is defined as a period of 10 years following the completion of Phase I Long Term Monitoring.

D. Closure: At the completion of the Phase II Long Term Monitoring, an escrow in favor of IDEM will be established in an amount equal to the total amount expended by the Trust for monitoring and maintenance in Phase II Long Term Monitoring (adjusted for inflation and the time value of money) for future inspection and maintenance and/or any contingent actions.

2.0 AUGMENTATION OF SVE SYSTEM - REMEDIAL ACTIONS

The primary objective of the Augmented SVE System is to treat subsurface water and soil contamination in the vicinity of the augmented SVE trench system and prevent off-site migration of contaminated subsurface water to Unnamed Ditch.

The sequence of activities for implementing the augmentation of SVE system are presented below.

- Installation of SVE trenches/wells along the east, south, west, and southwest sides of the ECC Site.

- Abandonment of on-site till wells.

- Installation of vertical SVE wells in the Separate Treatment Areas.

- Collection and treatment of subsurface water in the till and extraction of soil vapors via the augmented SVE trench system until attainment of Soil Vapor Standards.[2]

- Collect and treatment of till water and vapors via the vertical SVE wells in the Separate Treatment Areas until attainment of Soil Vapor Standards.

- Monitoring of surface and subsurface water.

- Control of the Site hydraulic gradient within the till unit using a permeable reactive gate system (PRGS).

Augmentation of SVE system activities, including the surface and subsurface water monitoring, are discussed in more detail in the following sections.

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[2] For the purposes of this document (Attachment Z-1), the term subsurface water in the till (till water) means the water within the saturated shallow unconsolidated glacial deposits composed predominantly of vertically heterogeneous clays and silts with occasional fine to coarse-grained sand lenses.

2.1 Well Abandonment

Prior to the construction of the augmented SVE trench system, all wells that are in the path of the augmented SVE trench system will be abandoned. Any wells located within the areas to be separately treated, herein referred to as the Separate Treatment Areas, will also be abandoned so as to avoid short-circuiting during operation of the SVE system in these areas. However, this will occur only after the proposed Separate Treatment Area dual-phase SVE wells have been installed and their effectiveness verified. In addition, the remaining on-site till wells will be abandoned following completion of the construction of the augmented SVE trench system. These on-site wells will allow the collection of water level measurements during the construction activities. The remaining off-site till wells (T-5 and T-10) as well as the proposed sand and gravel wells (S-1, S-4B and S-5) will be abandoned following the completion of the Phase I Long Term Monitoring. The wells that will be abandoned are:

- Wells in the path of the augmented SVE trench system and/or wells:
  T-6, T-7, T-8, T-9, S-2, S-3, ECC-MW-13, HT-1, CDW[3] and piezometer P-1.

- Wells in the vicinity of the Separate Treatment Areas:
  HS-1, HS-1A, HS-2 and IW-5.

- Remaining on-site[4] till wells:
  T-1, T-2, T-2A, T-3 and T-4A.

- Phase I Long Term Monitoring wells:
  T-5, T-10, S-1, S-4B and S-5.

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[3] Construction dewatering well located in the northeast portion of the former Southern Concrete Pad Area (SCPA).

[4] Till water will be monitored via trench system samples described herein; therefore, till wells are no longer needed.

In addition, well S-4A will be abandoned following the construction of its replacement well S-4B.[5] Figure 1 shows the locations of the wells to be abandoned.

The wells will be abandoned by removing the stickup protective casing (if present) and tremie grouting the well, from the bottom, with a bentonite/cement grout. The outer protective well casing will be removed and the inner PVC well casing will be cut to a depth of at least two feet below ground surface (bgs). The well screen and casing will then be tremie-grouted with a bentonite/cement mixture to within six inches of the ground surface, and the surface will be filled with soil or gravel, as appropriate. Within 30 days of the completion of the abandonment, the Indiana Department of Natural Resources – Division of Water will be notified in writing of the identification and location of the wells, and the procedures followed during the abandonment. The USEPA and IDEM will be copied on this notification.

2.2 Augmented SVE Trench System

The augmented SVE trench system will be used for SVE treatment of the shallow till along the east, south, and southwest sides of the Site.

2.2.1 The SVE Process – SVE Trenches

The SVE process takes advantage of the volatility of the contaminants to allow the mass transfer of volatile organic compounds (VOCs) and semi-volatile organic compounds (SVOCs) from adsorbed, dissolved, and free phases in the soil to the vapor phase, where it is removed under vacuum pressure. The basic operation for the ECC Site includes the extraction of air and water from the trench system. Because the SVE system dries any sand lenses, it is also effective in treating subsurface moisture in the till. Free liquid entrained in the air will be removed by gravity in an entrainment separator. Periodically, water that accumulates in the entrainment separator will be pumped to an on-site storage tank for subsequent treatment, as needed, and then to an on site discharge point in

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[5] ENVIRON believes that construction related activities conducted at the ECC site during 1998 and 1999 resulted in damage to the S-4A monitoring well. ENVIRON is proposing the replacement of this well. The new well (S-4B) will be installed approximately 50 feet to south of S-4A (down gradient of S-4A), in a low traffic area.

accordance with the substantive requirements of applicable federal and state laws. Vacuum pumps will also be used for the collection of contaminants via soil vapors. From the vacuum pumps, the collected vapor will pass through the existing carbon adsorption system, which consists of carbon columns connected in series. Appendix A contains a more detailed description of the on-site treatment system.

2.2.2 Augmented SVE Trenches

The preliminary augmented SVE trench system adds six segments (i.e., Segments 1 through 6) to the existing SVE trench layout, each of varying length[6,7](see Figures 2 and 3). Each of the augmented SVE trenches will be approximately 18 to 24 inches wide. The trenches will be situated to intercept permeable lenses in the till unit, above the sand and gravel unit (see Figure 4). It is anticipated that the existing ECC water treatment system will be sufficient to treat till water from these trenches. Riser pipes will be installed within each SVE trench to allow for initial removal of excess water, if necessary.

As shown on Figure 2, a 170-foot gap (approximate) will exist between the south end of the Segment 3 SVE trench and the north end of the Segment 4 SVE trench. A 50-foot gap (approximate) will also exist between the south end of the Segment 4 SVE trench and the east end of the Segment 5 SVE trench. Due to the irregular geology of this area and the limited depth of clay between the shallow and deeper sand and gravel lenses, SVE trenches could not be extended to these areas. For this reason, four dual-phase SVE wells may be installed between the Segment 3 and Segment 4 SVE trenches. In addition, two SVE wells proposed for Separate Treatment Area 2 are in close proximity to the gap between Segment 4 and Segment 5.

The discharge pipes from the augmented SVE trench system will run aboveground to an aboveground manifold, which leads to the existing ECC water

[6] Configuration of the trench system may be modified based upon any additional soil characterization activities desired by the contractors prior to installation, observations made during construction of the thin barrier curtain wall, and any unforeseen conditions identified during trench construction.

[7] The configuration presented herein does not represent a detailed or final design. Rather, the placement of the trenches has been presented to assist with the conceptual understanding of the intended construction theory. Final location of the augmented SVE trench system will be determined during the installation based on the field conditions.

treatment system. All SVE discharge piping will be protected from freezing using either soil berms or heat trace lines. Appendix A contains a description of the existing treatment system.

2.2.3 SVE Trench Installation Methodology

The excavated soil will be placed on the former Southern Concrete Pad Area (SCPA) following testing to ensure it does not exceed the Acceptable Soil Concentrations as listed in Revised Exhibit A, Table 3-1. Soil exceeding these standards will be treated on site or disposed of off site according to applicable USEPA and IDEM regulations. Details will be presented in the design report. The SVE trenches will be installed utilizing excavation equipment and a biopolymer such as natural or synthetic guar gum. The approximate locations and depths of the trenches are depicted on Figures 2 and 3, respectively. The excavations will be performed through the guar gum to prevent the trench walls from collapsing during the excavation and to reduce the potential of the lower sand and gravel unit from heaving at the bottom of the excavation.

The guar gum will be added to the trenches, as necessary, as the excavations proceed to maintain guar gum in the trench to within approximately two feet of the ground surface. Excavation spoils will be temporarily placed in staging areas adjacent to the trenches. As the spoils are stockpiled, the guar gum will drain from the spoils and flow back into the excavation. Berms and/or silt fencing will be added along the Unnamed Ditch to preclude potential guar gum solids or excavation spoils from entering the Ditch. Upon completion of the trench excavation activities, all stockpiled excavation spoils will be placed within the former SCPA.

The SVE trenches will be backfilled with pea gravel or similar granular material. The pea gravel backfill will be installed to within approximately two feet of the surface of each trench. As each trench is backfilled with pea gravel, a slotted four-inch diameter horizontal PVC pipe (SVE pipe) will be installed in the trench (see Figure 4). The optimum placement depth of the horizontal PVC pipe, within each trench segment, will be determined during the design phase. The potential fouling of the SVE pipe will also be considered during the design phase.

The horizontal slotted pipe will be fabricated with solid vertical PVC access pipes installed at three locations on each of the six excavation trenches. These vertical PVC access pipes will either be connected to the SVE system or will be capped and equipped with a vacuum gauge above the final grade of the trench. The multiple risers will be installed to allow the installation of additional equipment/instrumentation, if necessary, to monitor the effectiveness of the SVE system, and for the addition of enzymes necessary to dissolve the guar gum after completing each trench.

In addition, one four-inch diameter PVC riser pipe will be installed within each trench while backfilling is performed. These pipes will be installed at the low point of each trench and will be used for initial development and guar gum removal (see discussion below). Each PVC riser pipe will be equipped with a five or ten-foot section of PVC screen, as appropriate, depending on the total depth of the trench at the respective location of the riser pipe. Solid PVC casing will extend from the screen to the surface of the trench (see Figure 5).

After each trench is backfilled with pea gravel and the access pipe and PVC riser pipes are installed, an appropriate enzyme will be added by the contractor to dissolve the guar gum. The enzyme will be pumped out of the trenches using the four-inch diameter PVC riser pipes. Guar gum displaced during the excavation or guar gum removed from the PVC riser pipes during the enzyme addition will be containerized and characterized. After assessment of the laboratory results to characterize that dissolution of the guar gum is complete, the water will, if necessary, be treated in the on-site treatment system and managed/disposed of in accordance with applicable standards.

Additional soil will be removed at the surface of each trench to allow for the installation of a seal that will prevent vacuum leaks from the SVE trenches to the ground surface. A high-density polyethylene (HDPE) liner will be installed at the base of this excavation over the gravel backfill in each trench and will be keyed into the surrounding soil. The seal will then be backfilled with clay material and will be suitably compacted. The backfill may consist of the soils excavated to construct the seal.

After the seal is completed, a protective casing will be installed over the top of each PVC riser pipe. Excavations will be performed through the seal at each riser pipe location for the installation of the protective casing. A geotextile will be placed around the PVC riser for each well, across the pea gravel backfill in each excavation. Bentonite or grout will be placed over the geotextile and the base of the remaining portion of the excavation to seal the casing and to prevent leaks to the surface from the SVE trench. The protective casing will then be installed and the annular space around the casing will be backfilled and compacted as appropriate to maintain the integrity of the seal. Either hydraulic cement or silicon caulk will be used within the protective casing to seal the riser pipe from the well and the casing. An appropriate well cap will be installed to prevent vacuum leaks through the protective casing. A vacuum gauge will either be installed through the well cap or through the riser pipe in the casing. The surface of the protective casing will be installed approximately three inches above the surrounding grade to prevent water from ponding on the surface.

2.2.4 Thin Barrier Curtain Wall

The results of testing performed during November 1998 indicate that sand lenses within the till unit near Unnamed Ditch may be hydraulically connected to Unnamed Ditch. In response, the Augmented SVE System will include the construction of a thin barrier curtain wall along the east, south, and southeast sides of the ECC Site, adjacent to the augmented SVE trench system (see Figure 2). This will eliminate, *inter alia*, any connection between sand lenses in the till unit and Unnamed Ditch, thus significantly decreasing the volume of water being removed and treated. Appendix C contains the methodology to be used to construct the thin barrier curtain wall, as well as the associated piezometers that will be used to monitor the effectiveness of the thin barrier curtain wall.

2.3 Separate Treatment Areas - Dual-Phase SVE Wells

Soil vapor extraction wells will be installed within each of the Separate Treatment Areas at the Site. The objective of the installation and operation of the Separate

Treatment Area dual-phase SVE system is to remove and destroy VOCs and selected SVOCs from the subsurface till and till water within Separate Treatment Area 1/1A and Separate Treatment Area 2. The locations of the Separate Treatment Areas are shown on Figure 6.

The existing wells in the Separate Treatment Areas cannot effectively be converted to dual-phase extraction wells. The screened intervals for each of the existing Separate Treatment Area wells were designed to collect water, not vapor, from the contaminated sand lenses. Further, the existing Separate Treatment Area well screens do not intersect all of the sand lenses within the till unit at each of their respective locations. The dual phase SVE wells will have longer screened intervals that will extend across all the sand lenses encountered between the bottom of the till unit to approximately 5 feet bgs.

2.3.1 Separate Treatment Areas - SVE Well Locations and Installation

It is anticipated that the Augmented SVE System will include three single or dual-phase SVE wells within Separate Treatment Area 1/1A and two single or dual-phase extraction wells within Separate Treatment Area 2. The preliminary locations of these wells are shown on Figure 6. The SVE wells will be installed using standard hollow-stem auger drilling methods. The SVE wells will be constructed to intercept the sand and gravel lenses within the till unit, as shown on the schematic drawing included as Figure 7. As shown on Figures 8 and 9, each SVE well will consist of a 4-inch diameter, 10- to 20-foot long, PVC well screen[8] and sufficient schedule 40 PVC casing to reach the ground surface. A sand pack will be installed in the annular space around the SVE well screen, from the bottom of the borehole to a depth of two feet above the top of the screen. A 2 to 5 feet thick layer of bentonite pellets will then be placed over the sand pack to create a seal, and cement/bentonite grout will be used to fill the remainder of the annular space to the ground surface.

Continuous soil cores will be collected during the installation of each Separate Treatment Area SVE well. The soil cores will be collected using 24-inch

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[8] The screened lengths may vary based on placement. All screens will penetrate the shallow sand and gravel lenses within the shallow till but will be placed no less than two feet above the lower sand and gravel unit.

long, 2-inch outside diameter stainless steel split-spoon samplers. Standard split-barrel sampling procedures in accordance with the American Society for Testing and Materials (ASTM) Method D 1586 will be utilized. The split-spoon samplers will be opened in the field and screened for VOCs using a photoionization detector. All observations and readings will be recorded on a field log. The results of the field screening are not expected to alter the locations of the SVE wells; however, should any additional information result in a need for such considerations, the USEPA and IDEM will be informed of any proposed modifications to the scope of work.

All existing wells not used for extraction and within or immediately adjacent to the Separate Treatment Areas will be abandoned in accordance with the procedures described in Section 2.1 above. These wells will be abandoned after the proposed Separate Treatment Area single or dual-phase wells have been installed and after the effectiveness of the single or dual-phase wells has been verified.

2.3.2 Separate Treatment Areas - Till Water and Soil Vapor Removal

Each SVE well will be constructed as either a single-phase or dual-phase extraction system. The single-phase extraction system utilizes a blower to generate high airflow to remove both the liquid and vapor phases from the well. The dual-phase extraction system uses a submersible pump to remove the liquids from the well and a blower to extract the soil vapor. Figures 8 and 9 present schematics of typical single-phase and dual-phase SVE wells, respectively. A combination of single-phase and dual-phase systems will be installed in the Separate Treatment Areas, with at least one dual-phase system installed within each Separate Treatment Areas. The dual-phase wells will be used for the initial dewatering of the sand lenses within each of the Separate Treatment Area. The dual-phase SVE wells will be connected to the existing treatment system with both a dual-phase line and a liquid extraction line.

Up to two single-phase SVE wells will be installed in Separate Treatment Area 1/1A, and one single-phase SVE well will be installed in Separate Treatment Area 2. Each of the single-phase SVE wells will be constructed so as to be readily converted to dual-phase systems, if necessary. The single-phase SVE wells will be connected to the existing on-site treatment system using a single dual-phase line. The single-phase SVE wells can be pressurized, if needed, via the valve air inlet.

Till water extraction performance tests will be conducted within each Separate Treatment Area following the installation of the Separate Treatment Area SVE wells but prior to the installation of the single- and dual-phase extraction systems. The performance tests will be completed to verify the effectiveness of the new Separate Treatment Area wells and to estimate both the volume of till water that must be removed to dewater the sand lenses within each Separate Treatment Area as well as the required pumping rate to maintain the dewatered conditions. Appendix B contains the methodology to be used to perform the till water extraction tests.

The existing on-site treatment system will be used to treat the extracted water and vapor in accordance with Section 2.1.2 and Figure 2-3 of Revised Exhibit A. Appendix A contains a description of the existing treatment system. An auxiliary vacuum unit may be used to aid the existing treatment system blowers. The necessity of this unit will be determined during the design phase.

2.4 Well Installation

ENVIRON believes that construction related activities conducted at the ECC Site during 1998 and 1999 resulted in damage to the S-4A well. Therefore, the S-4A well will be replaced by a new well (i.e., S-4B). This new well will be installed approximately 50 feet to south of S-4A (i.e., down gradient of S-4A), in a low traffic area. The S-4A well will be abandoned following the installation of the S-4B well. The proposed location for S-4B is shown on Figure 1.

Following the construction of the augmented SVE trench system, a new sand and gravel unit well (i.e., S-5) will be installed south of the southeast portion of the thin barrier curtain wall. The proposed location for S-5 is also shown on Figure 1. Installation and construction details for wells S-4B and S-5 will be presented in the design report.

3.0 ACTIVE PHASE

3.1 Augmented SVE Trench System Vapor Removal

The augmented SVE trench system will be designed to achieve the Soil Vapor Standards described in Section 3.2 below. As with the Separate Treatment Area SVE system, the time required to attain the Soil Vapor Standards is dependent upon the adequate removal of water, the initial concentrations of the compounds of concern (COCs), the minimization of short-circuiting, the operating air flow rate and temperature, and the efficient diffusion of air through the soil pores. Based upon the previous SVE activities conducted at the Site, the attainment of shutdown standards is expected to occur within 3 to 6 months of operation of the dual-phase extraction systems in the augmented SVE trench system. However, the actual time may be longer or shorter.

3.1.1 Sample Collection Frequency and Methodology

The augmented SVE trench system will be installed to permit vapor samples to be collected from each individual SVE trench/well and from the combined vapor stream from all operating SVE trenches and wells. Vapor samples will be collected in accordance with the sample methodology previously agreed to by the USEPA and IDEM, and as presented in the April 28, 1997 Field sampling Plan (FSP). The vapor from each individual SVE trench and well will be sampled daily during the first week of operation, weekly for the following 4 weeks, and biweekly thereafter. The collected vapor samples will be analyzed for total organics using an existing in-line Series 8800 Continuous Analyzer and for the VOCs and SVOC presented in Section 3.2 below using NIOSH Methods 1500 and 1003 (modified), and OSHA Method 32, respectively. Also, the vapor flow rate will be monitored and recorded to provide sufficient data to calculate the mass of organics removed from the soils and the effectiveness of the system. The collected vapor sample data will be used to determine when individual SVE trenches/wells can be initially shut down.

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[9] Baseline Industries, Inc., Lyons, Colorado.

[10] The Separate Treatment Area SVE wells may remain in place until the completion of 5 years of monitoring of the Unnamed Ditch, as described in Section 3.3.

3.1.2 Augmented SVE Trench System Shutdown Methodology

The initial shutdown of the SVE system at individual trenches/wells will occur when two consecutive air samples from an individual trench/well show vapor concentrations to be less than or equal to the Soil Vapor Standards. When the vapor concentrations in each SVE trench/well are less than the Soil Vapor Standards, the restart spike method on the combined vapor flow will be used to demonstrate that the vapor standards have been achieved.

The restart spike procedure will include shutting down the entire trench/well vapor extraction system for a period of 3 days. On restarting the vapor extraction system, all SVE trenches/wells will be operated as during normal operations. A sample of the combined soil vapor will be collected over the time period (starting 30 minutes after restarting the SVE system) that is needed to exchange the air in one pore volume of soil to provide a representative sample of the soil vapor concentrations in equilibrium with the soil concentrations. If the combined sample exceeds the vapor standards, the system will be reactivated for a period of one week, and the shutdown process described above will again be implemented.

When results of analyses of the combined soil vapor sample collected from two consecutive restart spikes conducted once every 2 weeks show that concentrations of each COC meet the Soil Vapor Standards described Section 3.2 operation of the SVE system will be terminated subject to any restart required under Section 4.0, Item 1.

3.2 Soil Vapor Standards

The Soil Vapor Standards shown in Table 1 will be used, as described in the previous section, to determine shutdown of the augmented of SVE system. Table 1 represents a modification to Table 4-1 of Revised Exhibit A. The results of twelve vapor sampling events conducted between January 1999 and October 2000 were compared to the Table 4-1 standards. Those compounds that were previously detected in the vapor samples at concentrations above the Table 4-1 standards are shown on Table 1 herein, and the laboratory analysis of vapor samples collected as part of the operation of the augmented SVE system will include all such compounds. Compounds not detected within any of the January 1999 and October 2000 vapor samples will not be analyzed.

3.3 Surface Water Monitoring

During operation of the augmented SVE trench system, the surface water within the Unnamed Ditch will be monitored on a semiannual basis. The surface water samples will be collected upstream and downstream of the ECC Site and at the Northside Landfill discharge location within Unnamed Ditch, as depicted on Figure 10. Additional samples may be collected at the discretion of the ECC Site Trustees.

Surface water samples will be collected as described in Section 6.4 of the Revised Remedial Action FSP; Revision 4 dated April 28, 1998. The surface water samples will be analyzed for those COCs identified in Table 2, using USEPA Methods 8260B and 8270C. If surface water is not encountered, the specific sampling event will be considered complete despite the inability to gather a full set of data.

3.4 Subsurface Water Monitoring

During operation of the augmented SVE trench system, the subsurface water within the trench system and wells S-1, S-4B, and S-5 will be monitored on a semiannual basis. Wells S-1, S-4B, and S-5 are depicted on Figure 10. Additional samples may be collected at the discretion of the ECC Site Trustees.

Subsurface water samples will be collected from the wells as described in Section 6.3 of the Radian Revised Remedial Action FSP, Revision 4, dated April 28, 1998, with modifications outlined in the Low Flow Ground Water Sampling proposal dated November 10, 2000. The sampling procedure for the combined trench water sample will be presented within the design report.

The subsurface water samples will be analyzed for those COCs identified in Table 2, using USEPA Methods 8260B and 8270C. If subsurface water is not encountered in a well or trench, the specific sampling event, for that well or trench, will be considered complete despite the inability to gather a full set of data.

3.5 Separate Treatment Area Soil Vapor Removal

The Separate Treatment Area dual-phase SVE system will be designed to achieve the Soil Vapor Standards presented in Section 3.2. The time required to attain the vapor standards is dependent upon the adequate removal of water, the initial concentrations of the COCs, the minimization of short-circuiting, the operating air flow rate and temperature, and the efficient diffusion of air through the soil pores. Based upon the previous SVE activities conducted at the Site, the attainment of Soil Vapor Standards is expected to occur within 3 to 6 months of operation of the SVE wells in the Separate Treatment Areas.

3.5.1 Separate Treatment Area Sample Collection Frequency and Methodology

The SVE system will be installed to permit the collection of vapor samples from each SVE well and from the combined vapor stream from all operating SVE wells within the Separate Treatment Areas. Vapor samples will be collected in accordance with the sampling methodology previously agreed to by the USEPA and IDEM, and as presented in the April 28, 1997 FSP. The vapor from each individual SVE well within the Separate Treatment Areas will be sampled daily during the first week of operation, weekly for the following 4 weeks, and biweekly thereafter. The combined vapor samples will be analyzed for total organics using an existing in-line Series 8800 Continuous Analyzer[11] and for the VOCs and SVOCs presented in Section 3.2 using NIOSH Methods 1500 and 1003 (modified), and OSHA Method 32, respectively. Also, the vapor flow rate will be monitored and recorded to provide sufficient data to calculate the mass of organics removed from the soils and the effectiveness of the system.

The vapor samples collected from individual SVE wells within the Separate Treatment Areas at the beginning of the SVE system operation will be used to establish an initial concentration for each Separate Treatment Area well. This data will also be used to determine when individual SVE wells can be initially shut down.

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[11] Baseline Industries, Inc., Lyons, Colorado.

3.5.2 Separate Treatment Area System Shutdown Methodology

The initial shutdown of individual SVE wells within the Separate Treatment Areas will occur when two consecutive air samples from an individual well show vapor concentrations to be less than or equal to the Soil Vapor Standards. When the vapor concentrations in each SVE well are less than or equal to the vapor shutdown standards, the "restart spike" method on the combined vapor flow will be used to demonstrate that the Soil Vapor Standards have been achieved.

The "restart spike" method consists of periodically shutting down and restarting the Separate Treatment Area SVE system. By shutting down the system, equilibrium conditions between the vapor space within the soil and any remaining organics amenable to vapor extraction within the soil matrix are reestablished. Therefore, when the Separate Treatment Area SVE system is restarted, the initial organic compound concentrations in the extracted gas will be higher than under normal operation.

The restart spike procedure will include shutting down the SVE system for a period of 3 days. On restarting the SVE system, all Separate Treatment Area SVE wells will be operated as during normal operations. A sample of the combined soil vapor will be collected over the time period (starting 30 minutes after restarting the SVE system) that is needed to exchange the air in one pore volume of soil to provide a representative sample of the soil vapor concentrations in equilibrium with the soil concentrations.

The Soil Vapor Standards will be met when analyses of soil vapor samples collected from two consecutive restart spikes (conducted once every 2 weeks) show that concentrations of each COC meet the vapor standards described herein in Section 3.2. Once the Soil Vapor Standards have been achieved, the Separate Treatment Area SVE wells may be abandoned as described in Section 2.1.[12]

[12] The Separate Treatment Area SVE wells may remain in place until the completion of 5 years of monitoring of the Unnamed Ditch, as described in Section 4.0.

4.0 PHASE I LONG TERM MONITORING

The Phase I Long Term Monitoring period is defined as the 5-year period beginning when the Soil Vapor Standards have been achieved in both the Separate Treatment Areas and the augmented SVE trench system. Once the Soil Vapor Standards have been achieved, semiannual sampling and analysis of surface and subsurface water will continue for an additional 5 years, as described in Sections 3.3 and 3.4, respectively.

The water level within the augmented SVE trench system will be maintained by gravity drainage using the PRGS. Control of the water level within the trench system will control the hydraulic gradient within the till unit across the Site. The control of the hydraulic gradient within the Site till unit will prevent the flow of till water around the Augmented SVE System.

The PRGS will utilize the augmented SVE trench system to collect and convey till water by gravity to treatment gates containing zero-valent granular iron filings. This system is appropriate for the ECC Site COCs since this treatment technology has been demonstrated during numerous bench scale studies, pilot studies, and full-scale remediation projects for various chlorinated compounds in ground water and wastewater. The PRGS location, design and installation methodology will be presented within the design report.

Four performance criteria for the Phase I Long Term Monitoring have been determined. The actions to be taken in response to each of the performance criteria are different. The performance criteria and their respective proposed response actions are as follows:

1. The semi-annual subsurface water samples collected from the SVE trench system contain VOCs at concentrations greater than Acceptable Stream Concentrations (Table 2). If the VOC concentrations within the subsurface trench samples exceed the Acceptable Stream Concentration, then the augmented SVE system will be reactivated until the vapor meets the Soil Vapor Standards.

2. If the semi-annual monitoring events, using the water levels collected from the four thin barrier curtain wall piezometers, show that till water is flowing around the Augmented SVE system, then the necessary adjustments will be made to the PRGS.

3. The semi-annual surface water samples collected immediately downgradient from the Site, from Unnamed Ditch, contain VOCs at concentrations greater than the Acceptable Stream Concentrations (Table 2). If the VOC concentrations within the surface water samples exceed the Acceptable Stream Concentrations, then the source of these compounds will be investigated.

4. The semi-annual water level measurements to be collected from the thin barrier curtain wall piezometers will be used to confirm the integrity of the thin barrier curtain wall. If the thin barrier curtain wall is found to be leaking, then the wall will be repaired.

At the completion of the Phase I Long Term Monitoring, the activities dictated by the Consent Decree will be complete and the Site will enter an Indiana state program (i.e. Voluntary Remediation Program).

5.0 PHASE II LONG TERM MONITORING

The Phase II Long Term Monitoring period is defined as a period of 10 years following the completion of Phase I Long Term Monitoring. During the Phase II Long Term Monitoring period, maintenance of the cap and the PRGS system will be conducted on an annual basis. The PRGS will continue to control the hydraulic gradient across the Site, thus preventing the flow of till water around the thin barrier curtain wall. Monitoring of the surface water (in Unnamed Ditch) will be conducted on an annual basis.

6.0 CLOSURE

At the completion of the Phase II Long Term Monitoring period, the PRGS will be emptied and refilled with iron fillings and an escrow in favor of IDEM will be established in an amount equal to the total amount expended by the Trust for monitoring and maintenance in Phase II Long Term Monitoring (adjusted for inflation and the time value of money) for future inspection and maintenance by IDEM.

7.0 SCHEDULE

A preliminary schedule for the Augmentation of SVE System is presented on Table 3.

TABLES

Table 1
Soil Vapor Standards
Attachment Z-1
Enviro-Chem Superfund Site
Zionsville, Indiana

Compound	Soil Vapor Standard[1] (mg/L)	Soil Vapor Standard[1] (ppmv)
Methylene chloride	0.08	22
Methyl ethyl ketone	0.04	13
Trichloroethene	0.39	68
1,1,2-Trichloroethane	0.01	1
Tetrachloroethene	0.11	16
1,2-Dichloroethene (total)	3.7	880
Phenol	0.005	1.3

Notes:

[1] Soil Vapor Concentrations in Equilibrium with Acceptable Soil Concentration as presented in Revised Exhibit A, Table 4-1 for the above compounds.

Table 2
Stream Standards

Attachment Z-1
Enviro-Chem Superfund Site
Zionsville, Indiana

Compound	Stream Standard[1,2] (ug/L)
1,1-Dichloroethene	1.85
1,2-Dichloroethene (total)	9.4
Methylene chloride	15.7
Tetrachloroethene	8.85
Toluene	3400
1,1,1-Trichloroethane	5280
1,1,2-Trichloroethane	41.8
Trichloroethene	80.7
Vinyl chloride	525
1,2-Dichlorobenzene	763
Phenol	570

Notes:

[1] Acceptable Stream Concentration as presented in Revised Exhibit A, Table 3-1, as revised pursuant to footnote 4 of Table 3-1 of Revised Exhibit A.

[2] U.S.EPA and the Trustees have concluded that the west central surface water drainage channel from Northside Landfill (NSL) (constructed as part of the remedial action for that site) represents an upstream surface water concentration.

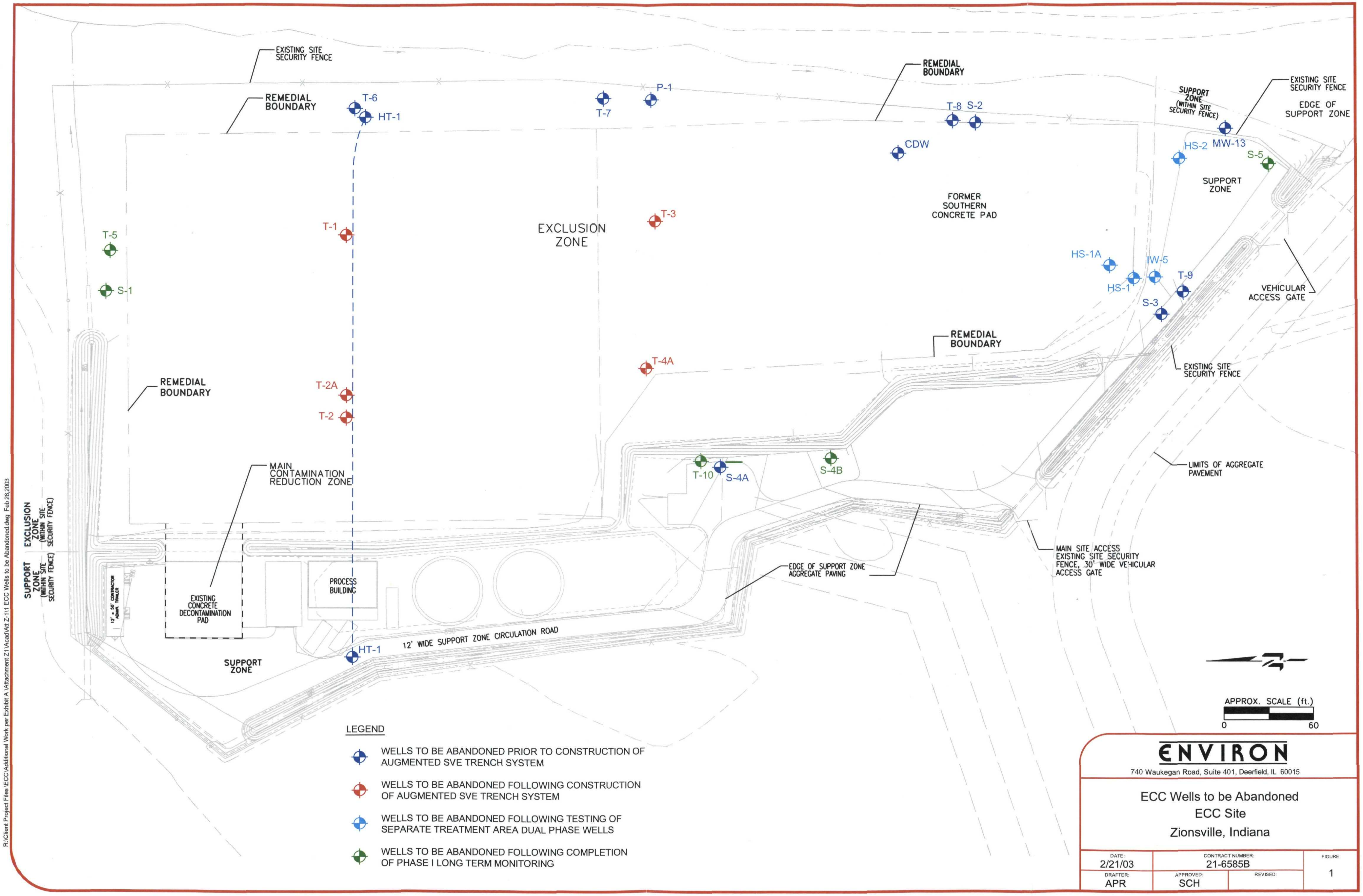
Table 3
Preliminary Schedule
Attachment Z-1
Enviro-Chem Superfund Site
Zionsville, Indiana

1.	**Attachment Z-1**	
	(a) Agency Review of Attachment Z-1	30 Days from submitting Attachment Z-1 to the Agency.
	(b) Meetings and Discussions with Agency	30 Day from Agency review of Attachment Z-1.
	(c) Incorporation of Agency Comments	30 Days from meeting with the Agency.
	(d) Agency Approval of Revised Attachment Z-1	14 Days from incorporation of Agency comments.
2.	**100% Design Report**	
	(a) Draft 100% Design Report to Agency	120 Days from Agency approval of Revised Attachment Z-1.
	(b) Agency Review of Draft 100% Design Report	30 Days from submitting the Draft 100% Design Report to the Agency.
	(c) Incorporation of Agency Comments	30 Days from receipt of Agency comments.
	(d) Agency Approval of 100% Design Report	30 Days from incorporation of Agency comments.
3.	**Bid Specification and Contractor Procurement**	
	(a) Obtain SOQs and Financial Information	30 Days from Agency Approval of 100% Design Report.
	(b) Preparation of Bid Specifications	45 Days from obtaining SOQs and financial information.
	(c) Contractor Bidding	45 Days from the preparation of bid specifications.
	(d) Contract Preparation/Award Contract	45 Days from the receipt of bids.
4.	**Attachment Z-1 Construction** [1]	
	(a) Augmented SVE Trench System	
	(b) Permeable Reactive Gates System	360 Days from awarding contract.
	(c) Separate Treatment Area System	
5.	**Construction Completion Report**	
	(a) Draft Completion Report to Agency	90 Days from completion of construction.
	(b) Agency Review of Draft Completion Report	30 Days from submitting the Draft Completion Report to the Agency.
	(c) Incorporation of Agency Comments	30 Days from receipt of Agency comments.
	(c) Agency Approval of Completion Report	30 Days from incorporation of Agency comments.
6.	**Operation of Augmented SVE System**	
	(a) Shutdown of SVE Trench System	180 Days from SVE Trench System startup.
	(b) SVE Trench System Spike Testing and Completion Report	90 Days SVE Trench System shutdown.
	(c) Agency approval of Completion Report	30 Days from completion of Trench System spike testing.
	(d) Shutdown of SVE Wells for Separate Treatment Areas	180 Days from Agency approval of Trench System Completion Report
	(e) Separate Treatment Area Spike Testing and Completion Report	90 Days from Separate Treatment Area SVE System shutdown.
	(f) Agency approval of Completion Report	30 Days from completion of Separate Treatment Area spike testing.
7.	**Phase I Long Term Monitoring**	5 Years from Achievement of Soil Vapor Standards in the Separate Treatment Areas and the Augmented SVE Trench System.
8.	**Phase II Long Term Monitoring**	10 Years from completion of Phase I Long Term Monitoring.

Notes:

[1] Detailed construction schedule to be included in 100% Design Report.

FIGURES



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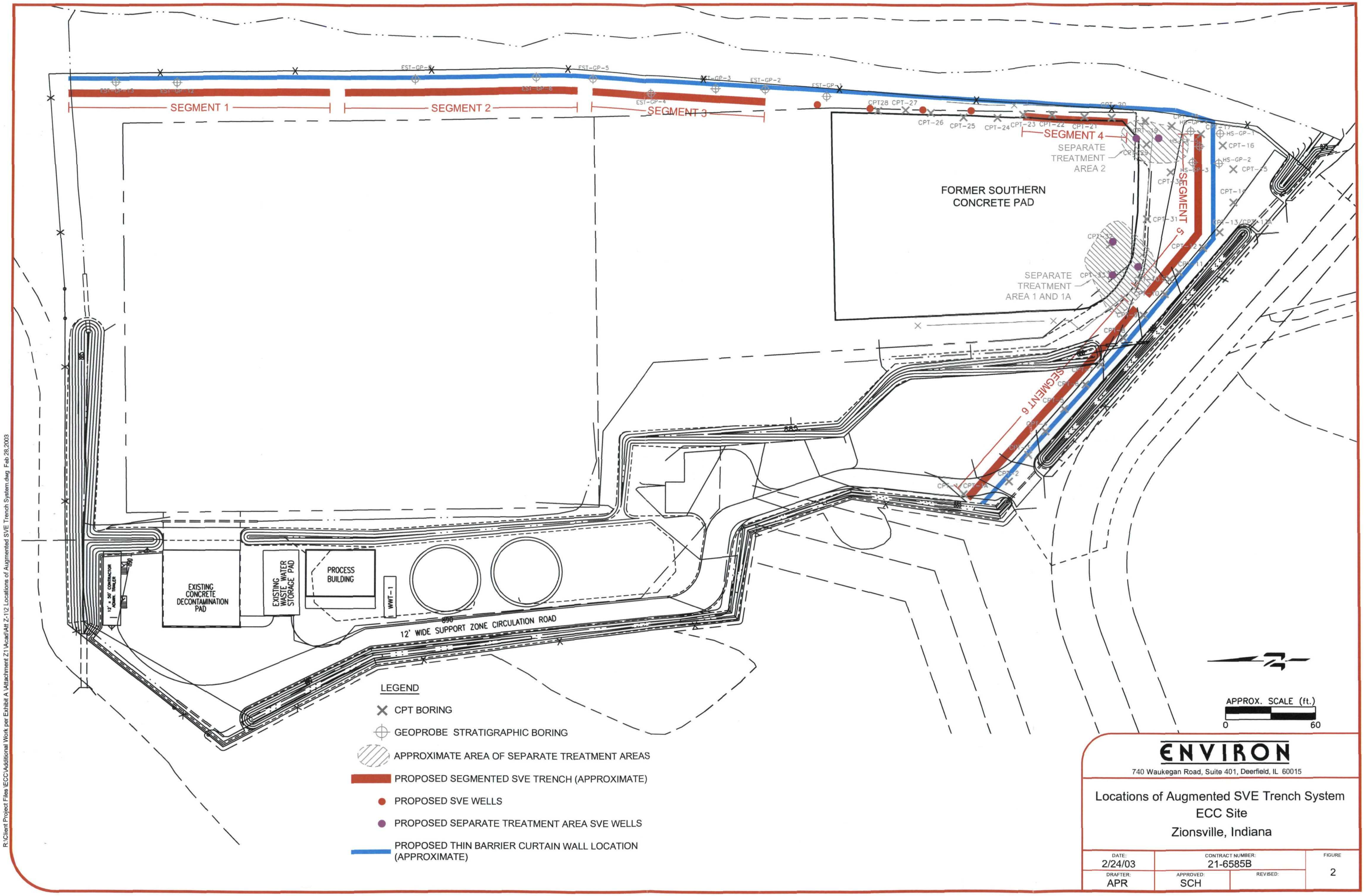

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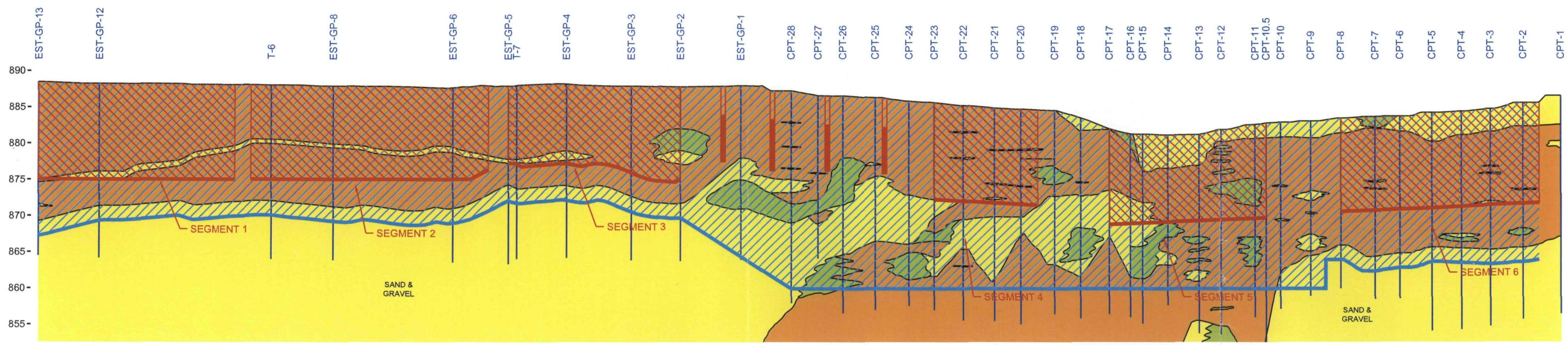


LEGEND

PROPOSED BOTTOM DEPTH OF SEGMENTED SVE TRENCH
(3 FT ABOVE TOP OF LOWER SAND & GRAVEL STRATUM (EXCEPT WHERE SHOWN AT ELEV. 868)).

PROPOSED SVE WELL LOCATION
(BOTTOM OF WELL LOCATED 1FT ABOVE TOP OF LOWER SAND & GRAVEL STRATUM)

PROPOSED THIN BARRIER CURTAIN WALL LOCATION
(2 FT INTO TOP OF LOWER SAND & GRAVEL STRATUM (EXCEPT WHERE SHOWN AT ELEVATION 860)).

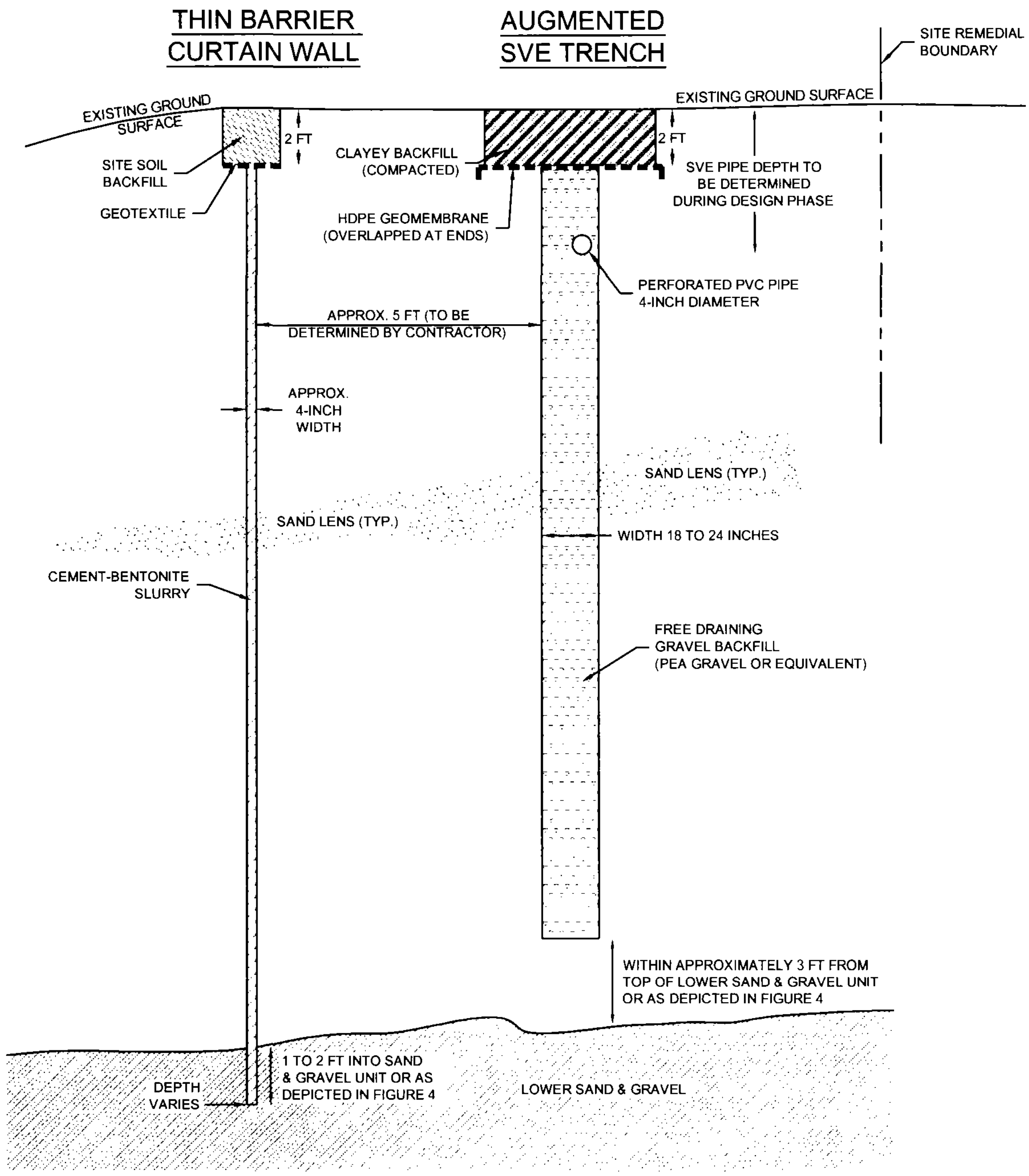
Note:
Soil profile shown is a simplified presentation of field data from the boring locations shown on Figure 2.

ENVIRON
740 Waukegan Road, Suite 401, Deerfield, IL 60015

Augmented SVE Trench System Profile View
ECC Site
Zionsville, Indiana

DATE:	CONTRACT NUMBER:		FIGURE
2/21/03	21-6585B		3
DRAFTER: APR	APPROVED: SCH	REVISED:	

R:\Client Project Files\ECC\Additional Work per Exhibit A\Attachment Z1\Acad\Att Z-1\C-2 & 3 Wall & Trench Profile Views.dwg Feb 28,2003



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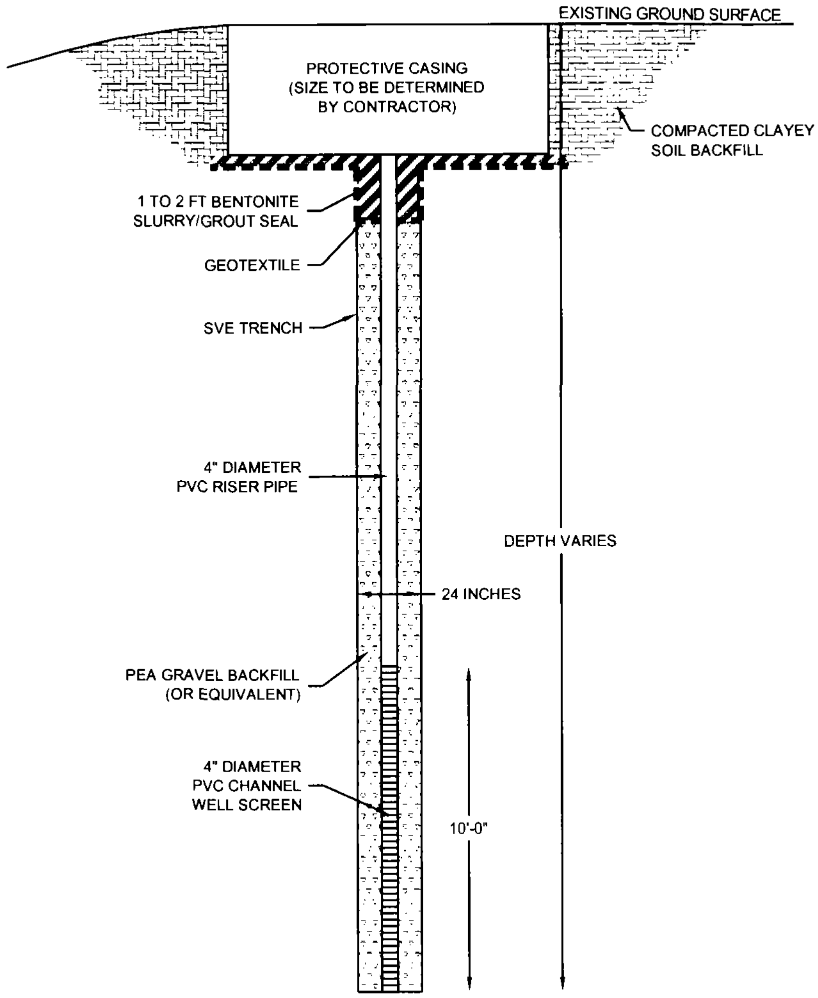
ENVIRON 740 Waukegan Road, Suite 401, Deerfield, IL 60015	Augmented SVE Trench Typical Section ECC Site Zionsville, Indiana	Figure 4

Drafter: APR | Date: 2/24/03 | Contract Number: 21-6585B | Approved: SCH | Revised:



TYPICAL SVE TRENCH WITH PVC RISER PIPE

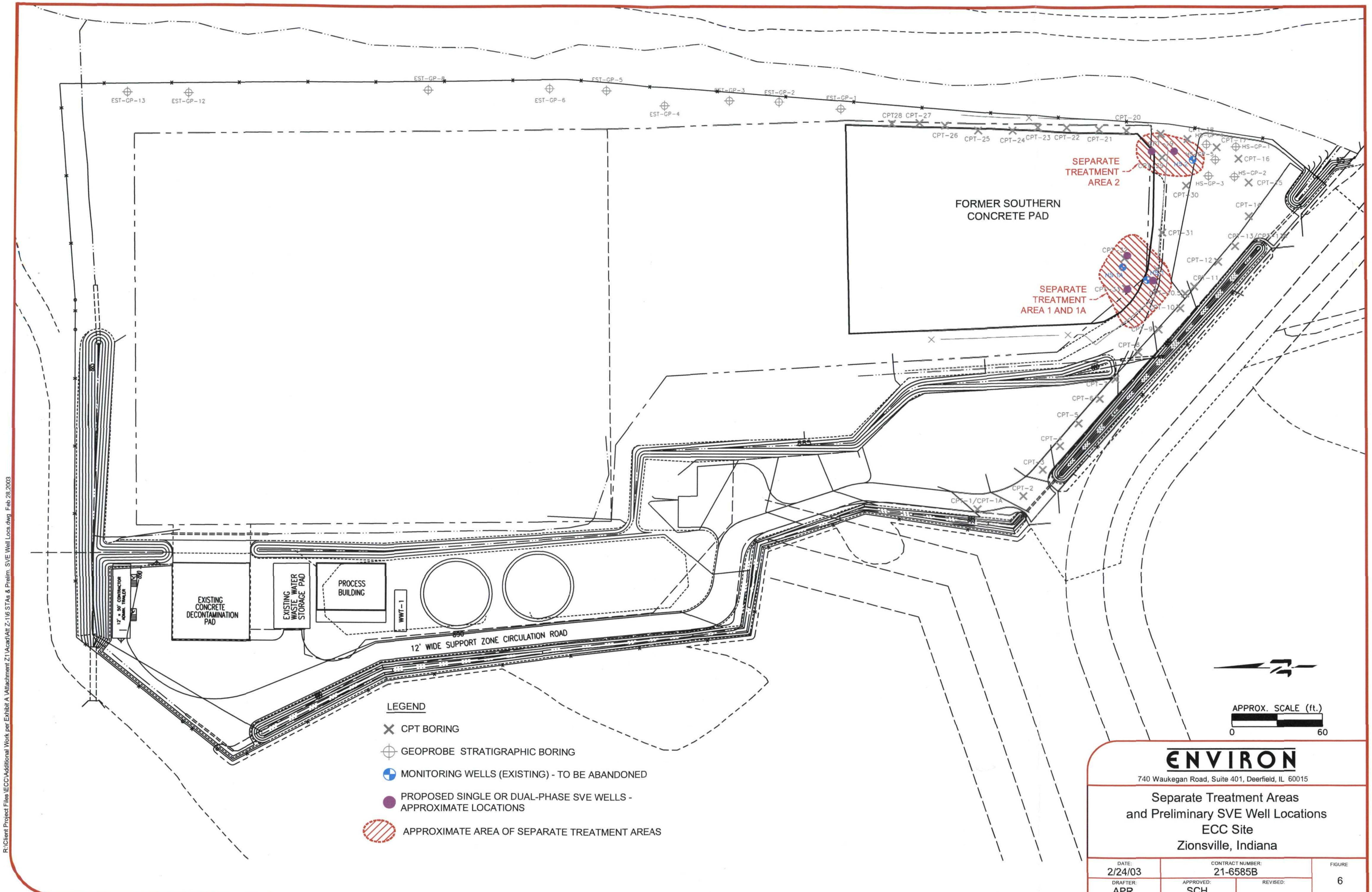
SCALE: 1" =6'

NOTES:

1. PVC RISER PIPE LOCATIONS TO BE DETERMINED DURING DESIGN PHASE
2. INSTALLATION DURING TRENCH CONSTRUCTION
3. WELL SCREENS AVAILABLE FROM USF JOHNSON SCREENS, ST. PAUL, MN

ENVIRON 740 Waukegan Road, Suite 401, Deerfield, IL 60015	Typical PVC Riser Pipe Augmented SVE Trench ECC Site Zionsville, Indiana	Figure 5

Drafter: APR Date: 2/24/03 Contract Number: 21-6585B Approved: SCH Revised:



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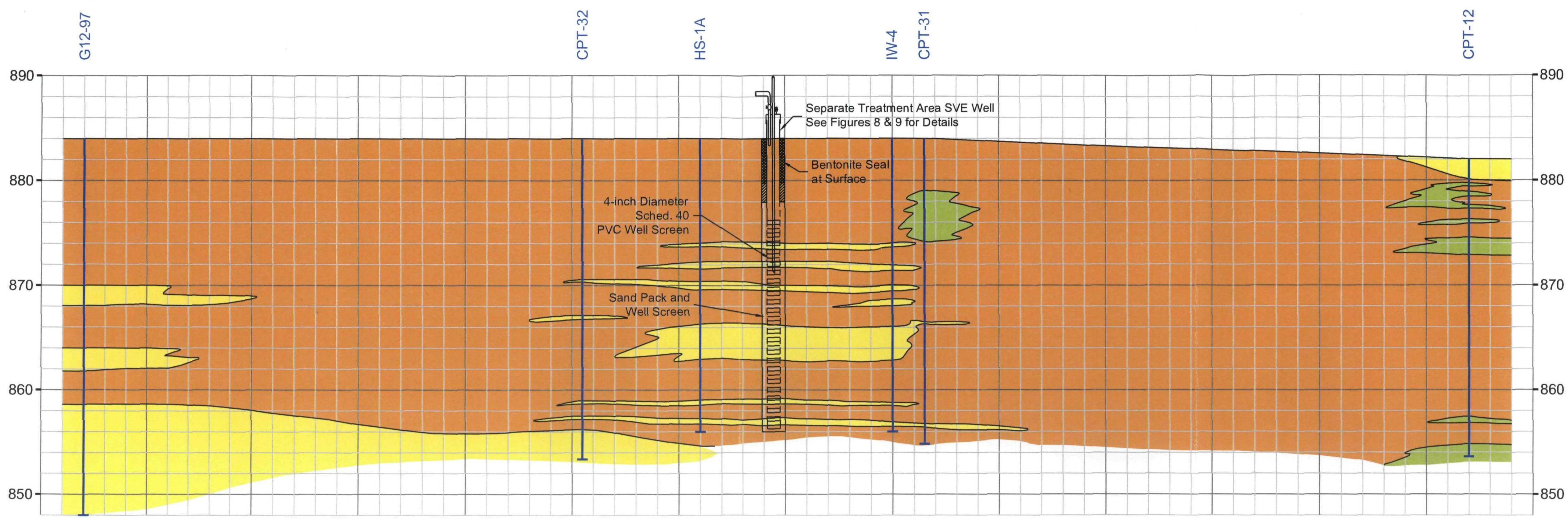
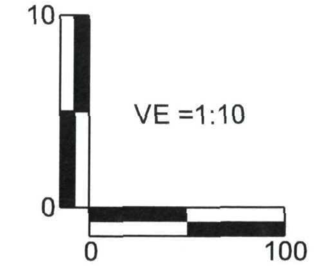


LEGEND

- CLAY TO SILT
- SILTY SAND
- FINE SAND TO GRAVEL



Note:
The screened lengths vary based on placement.
All screens will fully penetrate the upper sand and gravel lenses in the shallow till but will be placed no less than two feet above the lower sand and gravel unit.

Soil profile shown is a simplified presentation of field data from the boring locations shown on Figure 6.

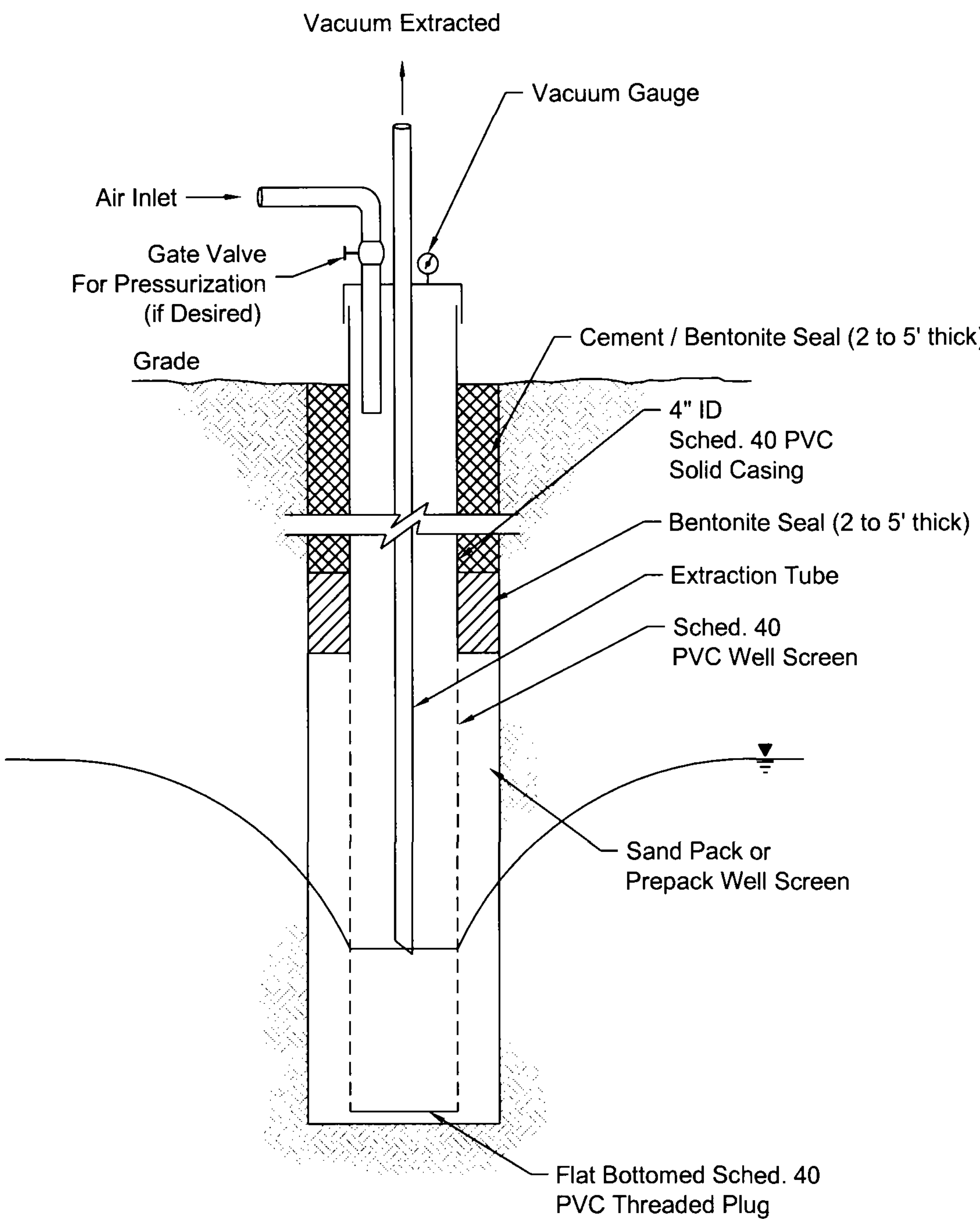
ENVIRON

740 Waukegan Road, Suite 401, Deerfield, IL 60015

Separate Treatment Area
SVE Well Profile Schematic
ECC Site
Zionsville, Indiana

DATE: 2/24/03	CONTRACT NUMBER: 21-6585B		FIGURE
DRAFTER: APR	APPROVED:	REVISED:	7

R:\Client Project Files\ECC\Additional Work per Exhibit A \Attachment Z1\Acad\Att Z-1\7 STA SVE Well Profile Schematic.dwg Feb 28,2003



R:\Client Project Files\ECC\Additional Work per Exhibit A \Attachment Z1\Acad\Att Z-11B Typical Single-Phase SVE Well.dwg Feb 28,2003

ENVIRON

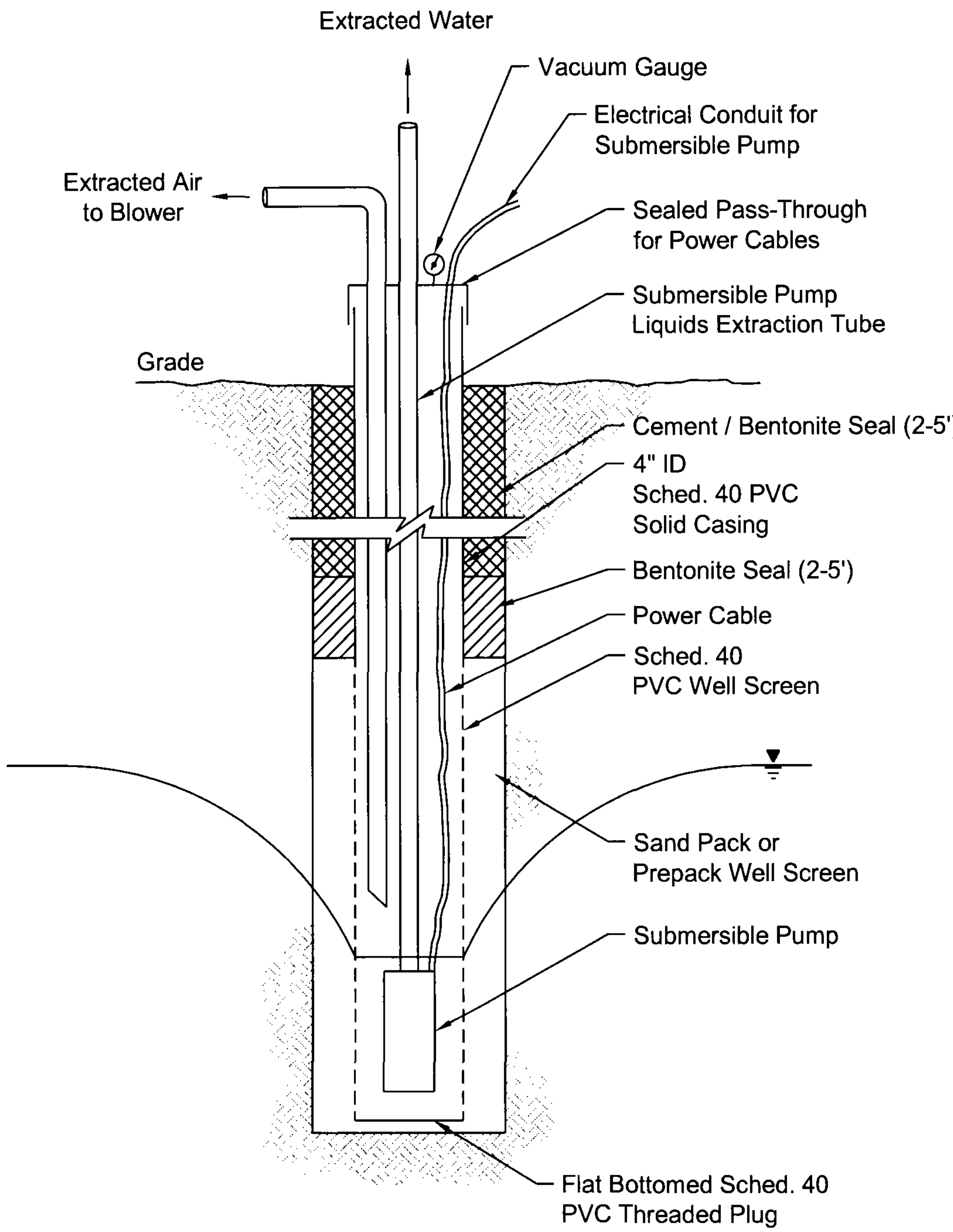
740 Waukegan Road, Suite 401, Deerfield, IL 60015

Typical Single-Phase SVE Well
ECC Site
Zionsville, Indiana

Figure

8

Drafter: APR | Date: 2/24/03 | Contract Number: 21-6585B | Approved: SCH | Revised:



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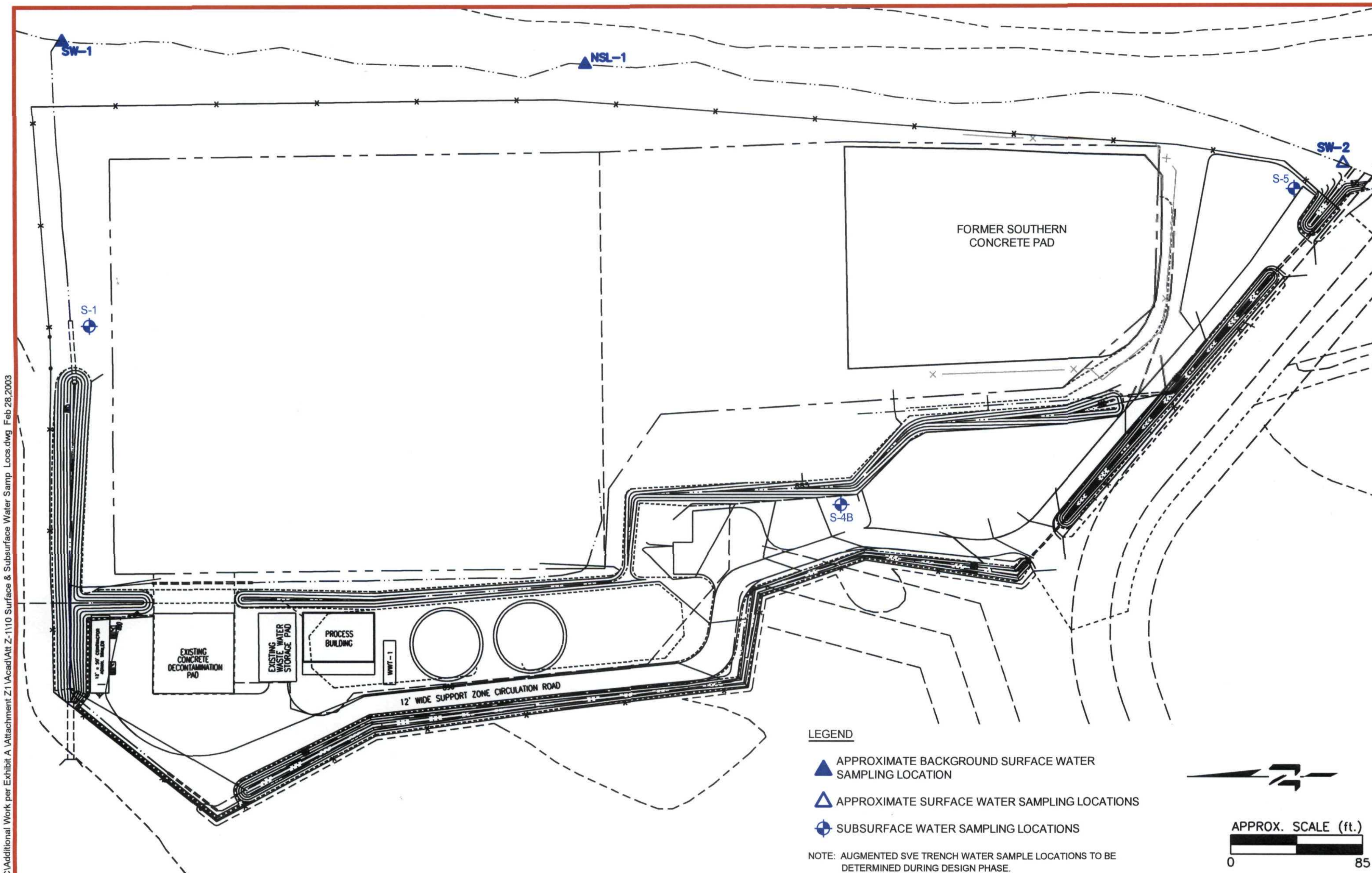
ENVIRON 740 Waukegan Road, Suite 401, Deerfield, IL 60015	Typical Dual-Phase SVE Well ECC Site Zionsville, Indiana	Figure 9

Drafter: APR Date: 2/24/03 Contract Number: 21-6585B Approved: SCH Revised:



R:\Client Project Files\ECC\Additional Work per Exhibit A\Attachment Z1\Acad\Att Z-1\10 Surface & Subsurface Water Samp Locs.dwg Feb 28,2003

ENVIRON

740 Waukegan Road, Suite 401, Deerfield, IL 60015

Surface and Subsurface Water Sampling Locations
ECC Site
Zionsville, Indiana

Figure

10

Drafter: APR | Date: 2/24/03 | Contract Number: 21-6585B | Approved: SCH | Revised:

APPENDIX A

Soil Vapor and Water Treatment System

SOIL VAPOR AND WATER TREATMENT SYSTEM

The objective of the SVE activity is to remove VOCs and selected SVOCs (as provided herein) from the shallow till along the east, south, and southwest sides of the Site, and from the Separate Treatment Area areas. The SVE system consists of two 60-horse power vacuum pumps with a design vacuum of 10 inches of mercury and a design backpressure of 1.25 inches of mercury. The design airflow is 1,175 cubic feet per minute (cfm) and the design discharge temperature is less than 175° Fahrenheit (F). Prior to treatment, the vapor is cooled to increase effectiveness of the carbon units. The heat exchanger has a normal airflow of 2,400 cfm and a normal water flow of 0.75 to 7 gallons per minute (gpm).

The potential effectiveness of SVE for organics removal from the ECC soils was demonstrated during a pilot test conducted by Terra Vac in June 1988. The description of the pilot test, including the results obtained, was previously submitted to the USEPA and the State of Indiana. The test showed an initial high organics extraction rate of 1.9 pounds per day per foot of SVE trench that decreased over the course of the pilot test to a steady state rate of approximately 0.25 pounds per day per foot of SVE trench.

The full-scale effectiveness of SVE has been demonstrated by the nine-foot-deep horizontal SVE trenches and by the vertical SVE wells T-2 and T-3. With respect to the nine-foot-deep horizontal SVE trenches, all trenches achieved compliance with the vapor standards within 25 months as verified by restart spikes over a 2-month period. With respect to T-2, the former testing well found to contain DNAPL, the extracted vapors met the vapor standards presented in Revised Exhibit A within a two-month period. With respect to T-1, the till water achieved compliance within two months. The only source of contaminants to be extracted is associated with till water and the subsequent equilibrium with the soils in contact with the granular lenses. Therefore, the time required to attain the Soil Vapor Standards for the augmented SVE system is anticipated to be three to six months.

The SVE process at the ECC Site is intended to operate continuously. However, automatic shutdown of the system will occur in the event of an operating problem or malfunction. As noted above, the air extracted from the system will be continuously monitored by in-line instrumentation. The system will allow for the collection of samples from the individual wells and SVE trenches or the combined air stream. Sample taps will also be provided to collect vapor samples for detailed chemical analysis. The existing on-line instrumentation includes a PID and moisture analyzer. The following are conditions that will prompt a shutdown of the normal operating sequence of the SVE system:

- High vapor temperatures above the estimated acceptable range of 150°F to 180°F prior to activated carbon treatment;

- Low vapor temperatures below the estimated acceptable range of 75°F to 85°F prior to activated carbon treatment indicating relative humidity above the estimated acceptable range;

- A high water level in the water entrainment separator indicating operating problems with the liquid transfer operation;

- A high water level in a water storage tank;

- High or low pressure conditions on vacuum or injection pumps under normal operating conditions; and

- Power interruptions at the Site.

During normal operation, vapor extraction may be temporarily halted to facilitate carbon vessel change out and during transfer of water from the entrainment separator to the on-Site water storage tank, or to conduct restart spike tests.

The vacuum vapor extraction system will be capable of removing water that accumulates in the SVE wells and trenches. Also, any free liquid in the extracted vapor will be separated by gravity in an entrainment separator. A level control system will be utilized to control the removal of water that accumulates in the entrainment separator as required. The existing separator tank is equipped with a vacuum breaker system which will open the tank to the atmosphere to permit water to be transferred by pump from the separator to an on-Site water storage tank as necessary.

The two existing 150,000-gallon storage tanks are sufficient to store the liquids for a period of time compatible with the selected water handling/treatment method. Periodically, the contents of the water storage tank will be removed for treatment and discharged on-Site in accordance with the substantive requirements of applicable federal and state laws or, if there is any off-site disposal, in accordance with all requirements of federal and state laws for off-site disposal, if any.

The exhaust from the soil vapor vacuum pump system is connected to a two-stage carbon adsorption system (i.e., primary and secondary). This system consists of two vessels in series containing granular activated carbon. The organics contained in the extracted air will be adsorbed on the activated carbon. The moisture content of the air stream will be less than 50% relative humidity, and temperatures will be maintained below 150° F by a cooling system -- both conditions that allow for efficient operation of the carbon adsorption unit.

The vapor from the primary carbon vessel will be monitored frequently by an existing on-line organic analyzer. When the organic analyzer detects organic vapor in the air stream between the primary and secondary carbon vessels, the SVE system will shut down automatically to permit the removal and replacement of the "spent" primary carbon vessel. An operator will be alerted to this condition by the shutdown alarm, and will disconnect the primary carbon bed from service. The spent carbon vessel will be removed and a carbon vessel containing fresh activated carbon will be placed in operation. The unit previously serving as the secondary carbon bed will become the primary carbon bed and the unit just placed in operation will be the secondary carbon bed. Once this switch is complete, the SVE system (i.e., vacuum pump and injection pump) will be restarted and the system operation resumed. The arrangement of two activated carbon vessels in series (i.e., primary and secondary) will permit optimal utilization of the activated carbon, and efficient capture of the organics. The spent carbon vessels will be stored on-site. The inlet and outlet connections to each carbon vessel will be capped and sealed appropriately. Periodically when a truckload quantity of vessels has accumulated, and at the conclusion of the SVE program, the vessels containing the spent carbon will be transported in accordance with the requirements of the applicable federal and state laws to an off-site facility where the carbon will be regenerated by high temperature incineration, and in the process, the organics adsorbed on the carbon will be destroyed.

If the SVE system is shut down due to a combination of (a) the need to shut down the water treatment system and (b) exceedance of on-site water storage capacity, and the shutdown of the SVE system for that reason continues for more than 5 days in any one month or for more than an average of 3 days per month (using a rolling average and for this purpose an assumed SVE operation time of 1 year), then water generated by the SVE system will be disposed of off-site so as to allow resumption of SVE system operation. Off-site water disposal, if any, will be performed in accordance with all requirements of federal and state laws and regulations. Off-site water disposal will terminate as soon as practicable once the on-site treatment system operation and storage capacity allow for resumption of on-site water management.[1] Wastewater discharges and vapor emissions from the existing treatment systems will be monitored to ensure attainment of the standards presented in February 1997 "Briefing Memorandum on ARAR Effluent Limits" prepared by IDEM.

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[1] Work Plans for the Adjacent Third Site Superfund Site are currently being prepared and some of the activities to be conducted on that site will include the collection of ground water. It is anticipated that waters collected from Third Site will also be sent to the existing water treatment plant. The ECC Site Trustees and the Third Site Trustees will ensure that the schedules for the activities at both sites are such that treatment system capacity exceedances will not occur.

APPENDIX B

Separate Treatment Areas
SVE Well Performance Test

SEPARATE TREATMENT AREAS - SVE WELL PERFORMANCE TEST

Till water extraction performance tests will be conducted within each Separate Treatment Area following the installation of the Separate Treatment Area SVE wells but prior to the installation of the single- and dual-phase extraction systems. The performance tests will be completed to estimate the volume of till water that must be removed to dewater the sand lenses within each Separate Treatment Area as well as the required pumping rate to maintain the dewatered conditions. The tests within each Separate Treatment Area will be conducted at a well designated for a dual-phase extraction system.

The first part of the performance test (i.e., Test 1) within each Separate Treatment Area will consist of pumping one well at a sufficient rate to initially cause the water level within that well to drop by several feet. The water levels within the surrounding wells located within that Separate Treatment Area will be monitored to determine the extent of dewatering. The second part of the performance test (i.e., Test 2) will include the pumping of till water until the water level in the pumping well is within one foot of the bottom of the well and the water levels within the other Separate Treatment Area wells have stabilized. The pumping rate required to dewater the well determined in Test 1, the pumping rate required to maintain the dewatered condition determined in Test 2, the volume of water removed from the SVE well, and the time needed to dewater the well will be recorded.

If Test 2 cannot be completed due to an inability of the pumping well to lower the water level to well within one foot of the bottom of the well, a step drawdown test will be conducted within the well. The step drawdown test will be conducted by pumping the well at three or more successive rates, while allowing the water level within the pumping well to stabilize for each pumping rate. The step drawdown test is an alternative method to determine the pumping rate required for dewatering the Separate Treatment Areas.

The results of the performance tests will be used to verify the number of SVE wells needed, to identify the specifications for the submersible pumps for the dual-phase extraction wells, and to verify the adequacy of the existing on-site treatment systems. Following analysis of the results, a performance test report will be prepared and submitted to the USEPA and IDEM. The report will provide descriptions of the performance test methodologies, test observations and results, and recommendations for the final SVE well configuration and components.

APPENDIX C

Thin Barrier Curtain Wall

THIN BARRIER CURTAIN WALL

A thin barrier curtain wall, to be constructed as part of the Augmented SVE System, will be installed along the east, south, and southeast sides of the ECC Site, adjacent to the SVE trenches/wells (see Figure 2). The thin barrier curtain wall will eliminate, *inter alia*, any connection between the sand lenses in the till unit and the Unnamed Ditch, thus significantly decreasing the volume of water to be removed and treated.

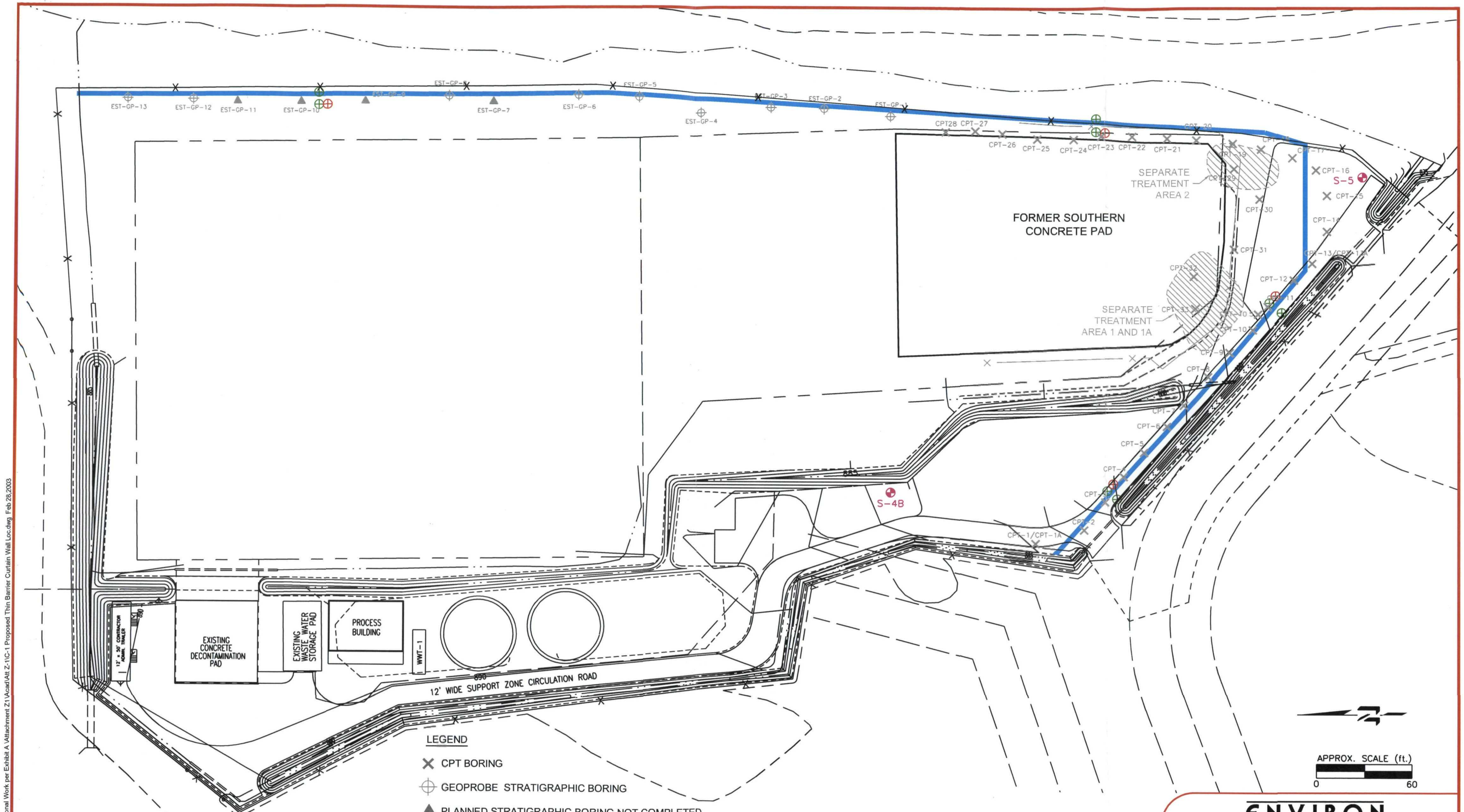
The thin barrier curtain wall will be approximately 1,100 feet long, 4 inches wide, and of varying depth. The proposed location for the thin barrier curtain wall is shown on Figure C-1 and a profile view of the curtain is shown of Figure C-2. It is presently contemplated that the thin barrier curtain wall will be installed using the Vibrated Beam Method,[1] although conventional slurry wall trench construction methods will be considered. The vibrated beam installation technique utilizes a special crane-suspended I-beam connected to a powerful vibrator. The beam is locked in a guide frame for exact positioning and stabilized by a hydraulic foot that provides guidance and aids in keeping the wall vertical. Cement/bentonite slurry is injected under pressure through a set of nozzles located at the base of the vibrated beam. At the completion of each panel, the rig is moved along the direction of the wall, the previous insertion is overlapped to ensure continuity, and the entire process is repeated. The wall is installed with minimal soil excavation requirements.[2] The result is an approximately 4-inch thick wall made of a bentonite and cement mixture, with a resulting permeability of 1×10^{-8} cm/sec or less. A cross-section view of the thin barrier curtain wall is shown on Figure C-3. The thin barrier curtain wall will provide a continuous low permeability boundary, thus blocking flow through the higher permeability sand and gravel lenses in the shallow till.[3]
Four sets of piezometers will be installed along the length of the thin barrier curtain wall in order to monitor hydraulic gradients in the till and sand and gravel units. One pair of

---

[1] Patent held by Slurry Systems, Inc. of Gary, Indiana.
[2] An approximately 2-foot deep excavation will be required along the length of the excavation trenches. The excavated soil will be placed on the former SCPA following testing to ensure it does not exceed the soil standards listed in Revised Exhibit A, Table 3-1. Soil exceeding these standards will be treated on site or disposed of off site according to applicable USEPA and IDEM regulations. Details will be presented in the design report.
[3] To the extent feasible, the thin barrier curtain wall will not be constructed during the winter months and the construction of the augmented SVE trench system will overlap the construction of the curtain wall.

piezometers for each set will be installed on either side of the thin barrier curtain wall within the till unit. The third piezometer for each set will be installed within the sand and gravel unit, adjacent to the upgradient till unit piezometer. Three of the piezometer sets will be installed in the general areas of T-6, T-8, and T-9. These locations will provide a comparison of historic and post-curtain wall till water levels. The fourth set of piezometers will be installed at the western end of the south trench and will verify that on-site subsurface water is not migrating around the trench.

The piezometers will be installed following the construction of the augmented SVE trenches. Construction details will be presented in the design report.



LEGEND

- CPT BORING
- GEOPROBE STRATIGRAPHIC BORING
- PLANNED STRATIGRAPHIC BORING NOT COMPLETED
- APPROXIMATE AREA OF SEPARATE TREATMENT AREAS
- PROPOSED THIN BARRIER CURTAIN WALL LOCATION (APPROXIMATE)
- PROPOSED TILL UNIT PIEZOMETER
- PROPOSED SAND AND GRAVEL UNIT PIEZOMETER
- PROPOSED SAND AND GRAVEL MONITORING WELL

NOTE:
Proposed Thin Barrier Curtain Wall location based Additional Work, Subsurface Water Interceptor Trench location, as shown on Figure 3-1 of Revised Exhibit A, with the following exceptions:

1. Proposed Thin Barrier Curtain Wall has been extended south of Separate Treatment Area 2.
2. Proposed Thin Barrier Curtain Wall location has been terminated at drainage swale near main access gate to maintain existing drainage swale and because access agreements do not extend beyond fence line.

ENVIRON
740 Waukegan Road, Suite 401, Deerfield, IL 60015

Proposed Thin Barrier Curtain Wall Location - Plan View
ECC Site
Zionsville, Indiana

DATE:	CONTRACT NUMBER:		FIGURE:
2/21/03	21-6585B		C-1
DRAFTER: APR	APPROVED: SCH	REVISED:	

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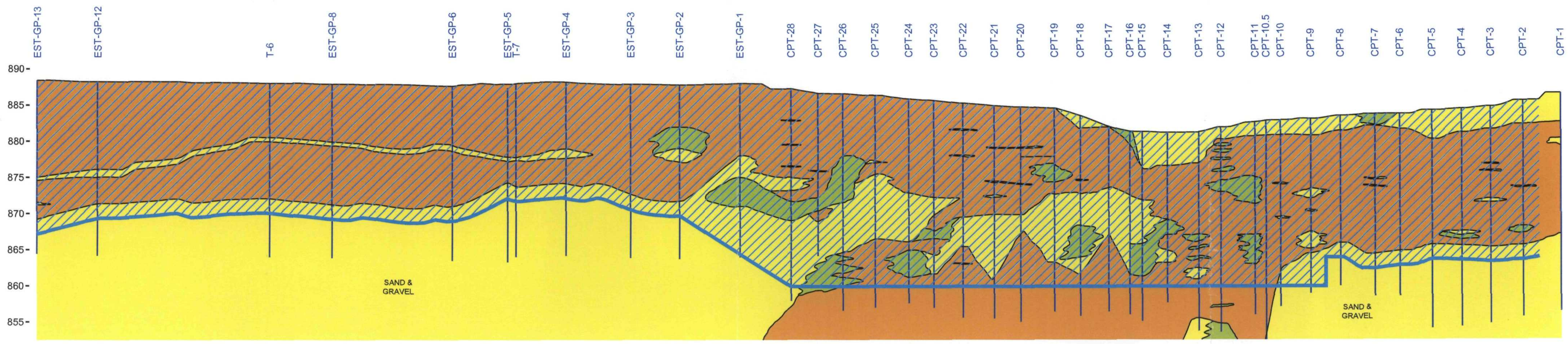


LEGEND

PROPOSED THIN BARRIER CURTAIN WALL LOCATION
(2 FT INTO TOP OF LOWER SAND & GRAVEL STRATUM (EXCEPT WHERE SHOWN AT ELEVATION 860)).

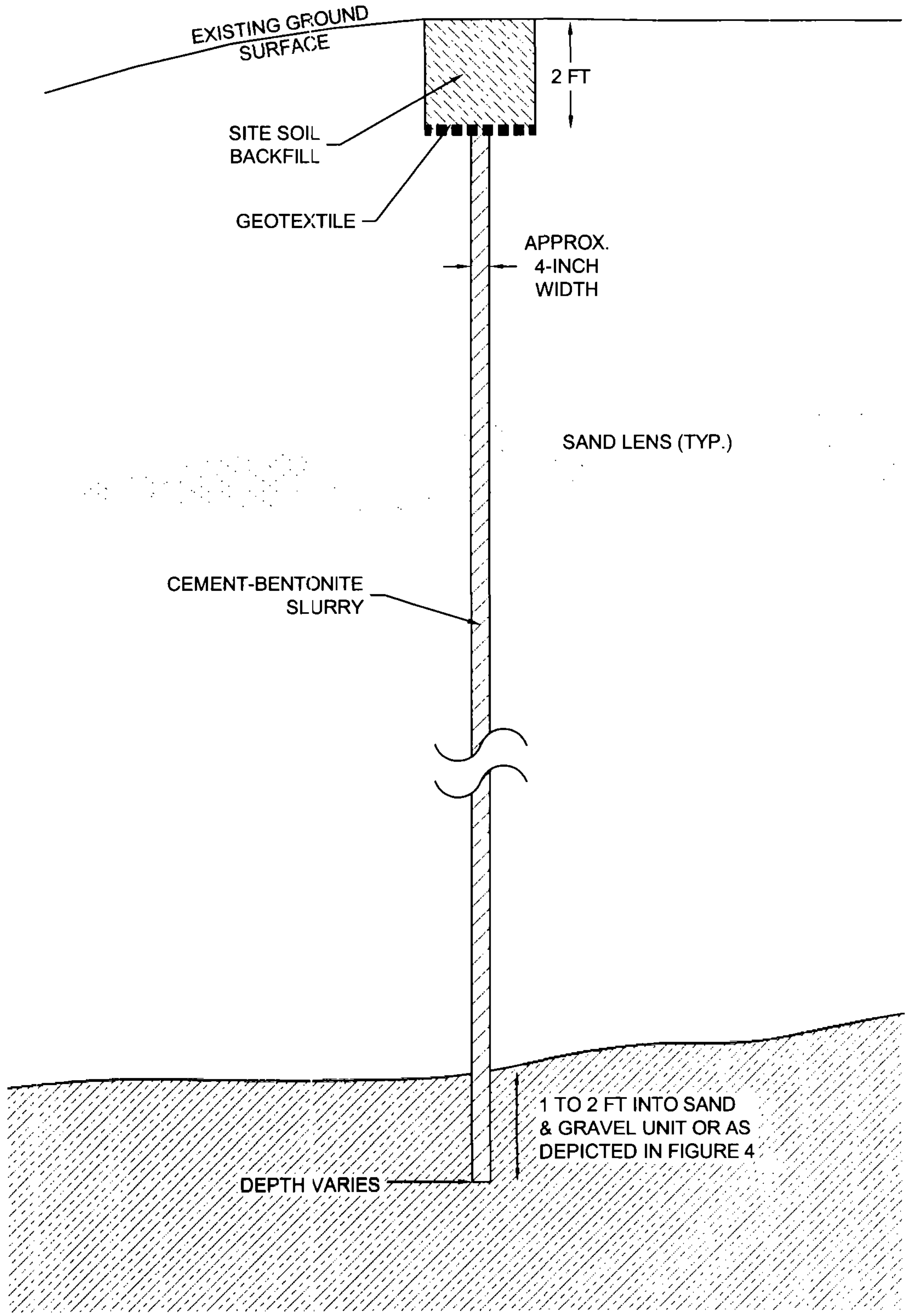
ENVIRON
740 Waukegan Road, Suite 401, Deerfield, IL 60015

Thin Barrier Curtain Wall - Profile View
ECC Site
Zionsville, Indiana

DATE: 2/21/03	CONTRACT NUMBER: 21-6585B		FIGURE
DRAFTER: APR	APPROVED: SCH	REVISED:	C-2

R:\Client Project Files\ECC\Additional Work per Exhibit A\Attachment Z1\Acad\Att Z-1\C-2 & 3 Wall & Trench Profile Views.dwg Feb 28,2003

THIN BARRIER CURTAIN WALL



ENVIRON
740 Waukegan Road, Suite 401, Deerfield, IL 60015

Thin Barrier Curtain Wall Typical Section
ECC Site
Zionsville, Indiana

Figure
C-3

Drafter: APR Date: 2/24/03 Contract Number: 21-6585B Approved: SCH Revised: